US007300219B2

(12) **United States Patent**
Lee

(10) **Patent No.: US 7,300,219 B2**
(45) **Date of Patent: Nov. 27, 2007**

(54) **IMAGE FORMING APPARATUS USING THERMAL PRINTING HEAD**

(75) Inventor: **Yong-duk Lee**, Gunpo-si (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/328,102**

(22) Filed: **Jan. 10, 2006**

(65) **Prior Publication Data**

US 2006/0263135 A1 Nov. 23, 2006

(30) **Foreign Application Priority Data**

May 20, 2005 (KR) 10-2005-0042466

(51) **Int. Cl.**
B41J 25/304 (2006.01)
B41J 2/32 (2006.01)

(52) **U.S. Cl.** **400/120.17**; 347/198; 347/197; 400/120.16

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,156,467	A	10/1992	Kitahara et al.	
5,181,787	A *	1/1993	Hosomi	400/120.16
5,348,283	A *	9/1994	Yanagi et al.	271/127
5,850,246	A *	12/1998	Maslanka et al.	347/197
5,933,180	A *	8/1999	Ruckl et al.	347/197
6,011,571	A *	1/2000	Lardant et al.	347/197
6,278,472	B1 *	8/2001	Sasaki et al.	347/175
2003/0184640	A1	10/2003	Sasaki	

FOREIGN PATENT DOCUMENTS

JP	58-011161	1/1983
JP	59-194878	11/1984
JP	02-235767	9/1990
JP	03-221464	9/1991
JP	05-229149	9/1993

* cited by examiner

Primary Examiner—Daniel J. Colilla
(74) *Attorney, Agent, or Firm*—Roylance, Abrams, Berdo & Goodman, L.L.P.

(57) **ABSTRACT**

An image forming apparatus that uses a thermal printing head (TPH) is provided. The image forming apparatus includes a platen roller. A TPH unit faces the platen roller and pivots to contact or separate from the platen roller. A first elastic member elastically biases the TPH unit toward the platen roller. A pair of cam levers are provided on both sides of the TPH unit. A pair of rotation cams contact the pair of cam levers and allow the TPH unit to pivot according to a rotation angle of the rotation cams.

16 Claims, 14 Drawing Sheets

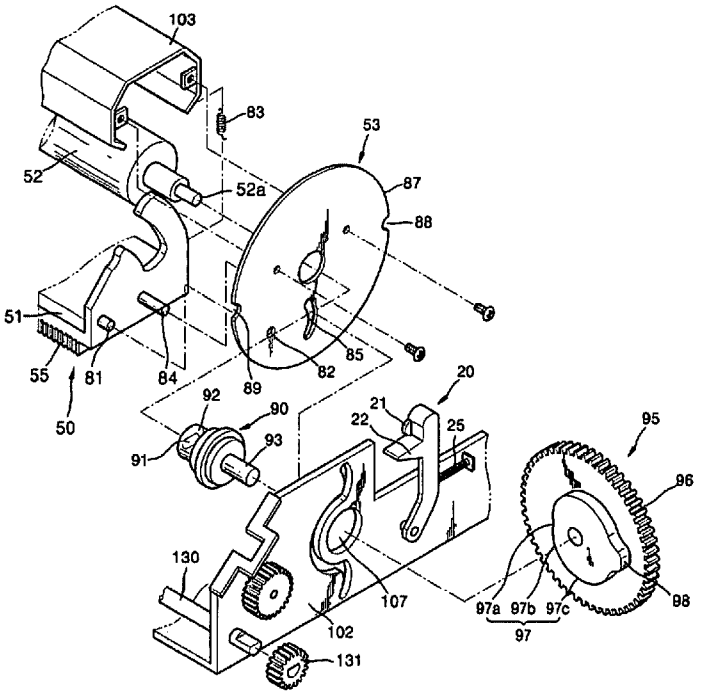

FIG. 1

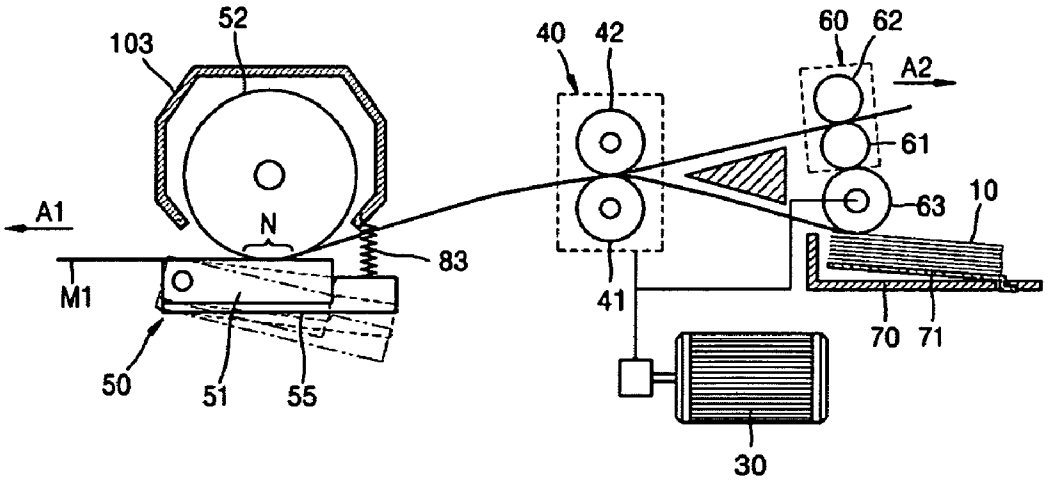
103
52
40
42
60
62
A2
61
63
10
A1
N
83
M1
41
70
71
50
51
55
30

FIG. 2

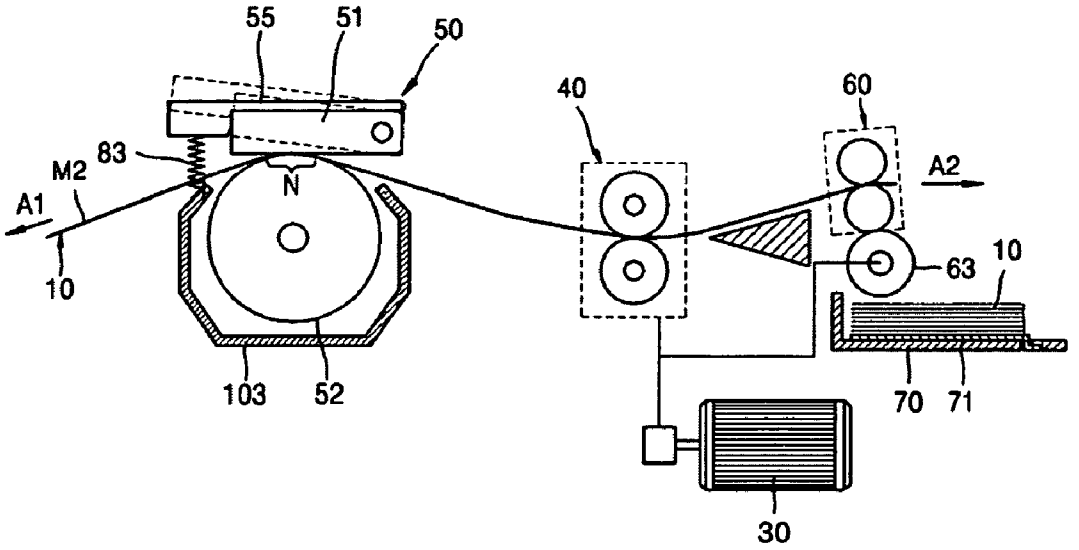
55
51
50
40
60
A2
M2
83
A1
N
63
10
10
70
71
103
52
30

FIG. 3

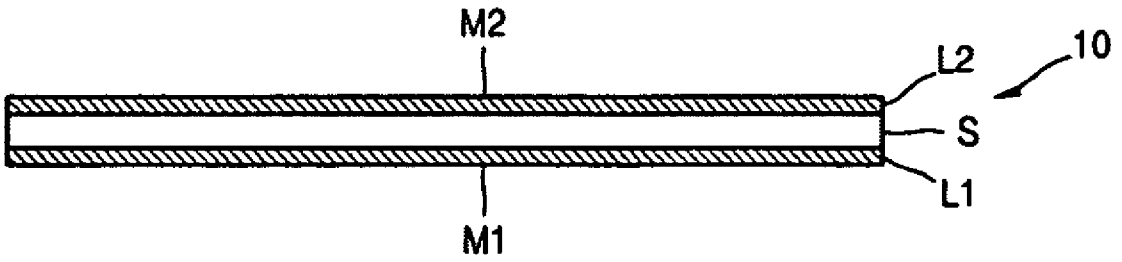

FIG. 4

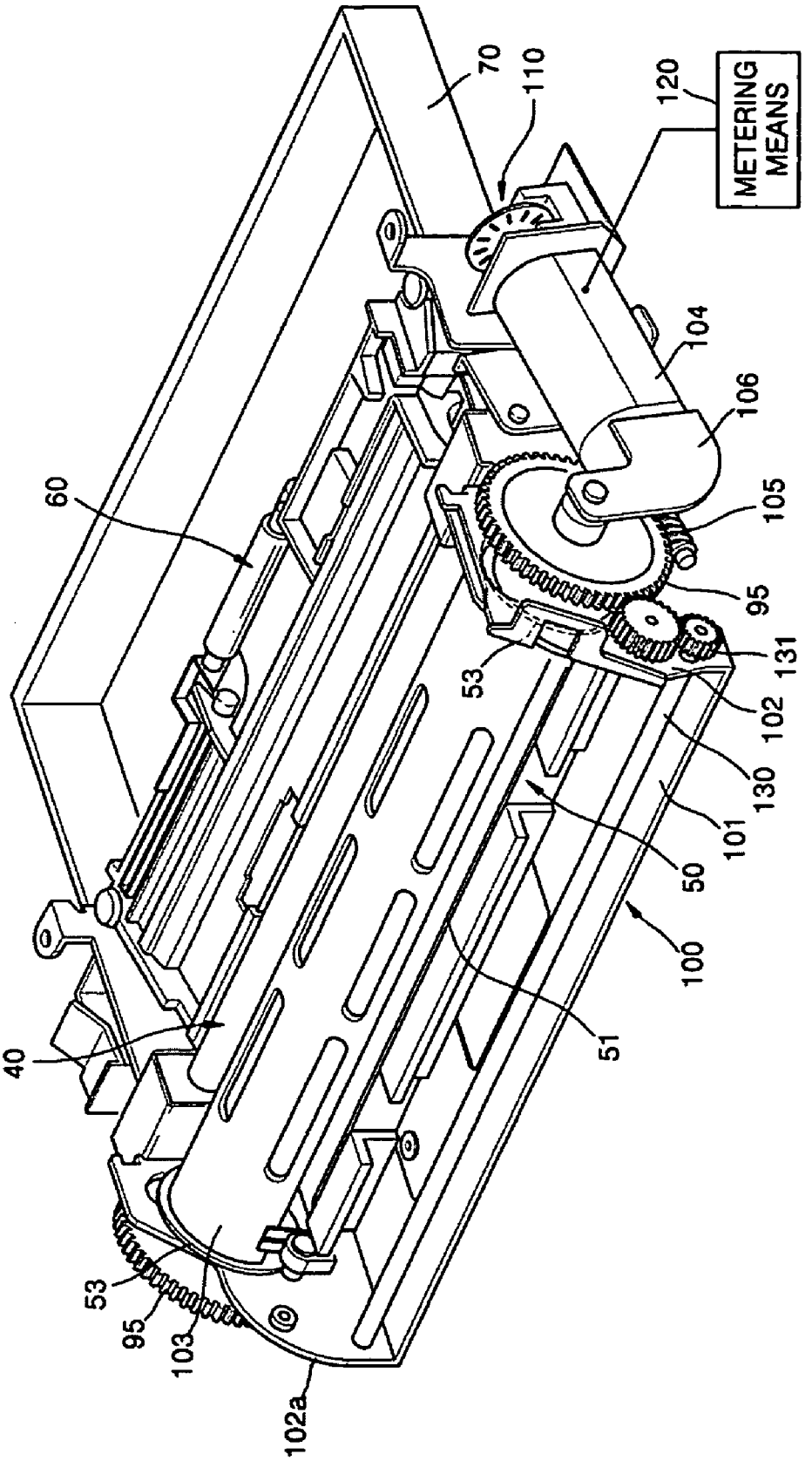
70
110
120
METERING MEANS
104
106
105
95
131
102
130
101
50
100
51
60
53
40
53
95
103
102a

FIG. 5

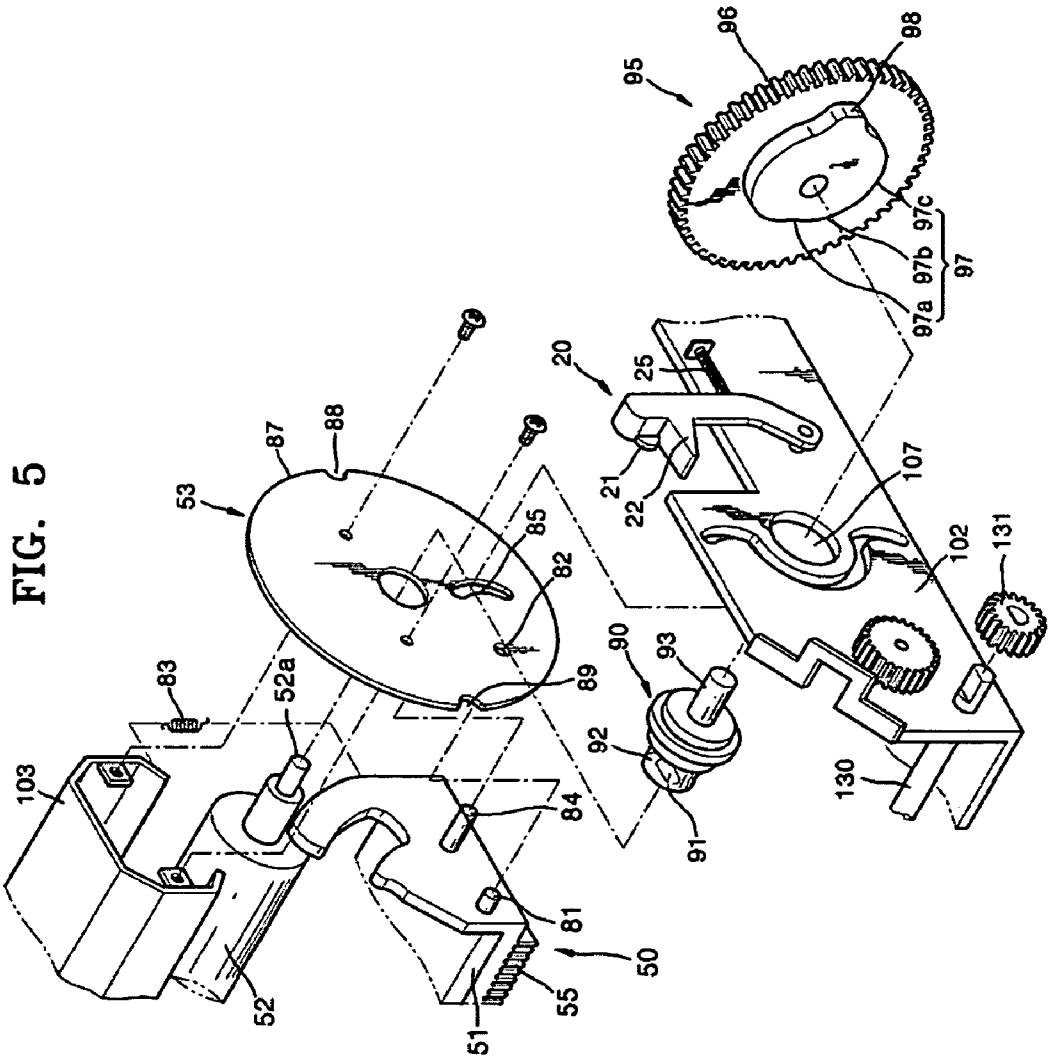
95
96
98
97c
97b
97a
97
20
25
21
22
107
102
131
130
53
87
88
85
82
89
83
52a
103
84
81
50
52
55
51
90
93
92
91

FIG. 6

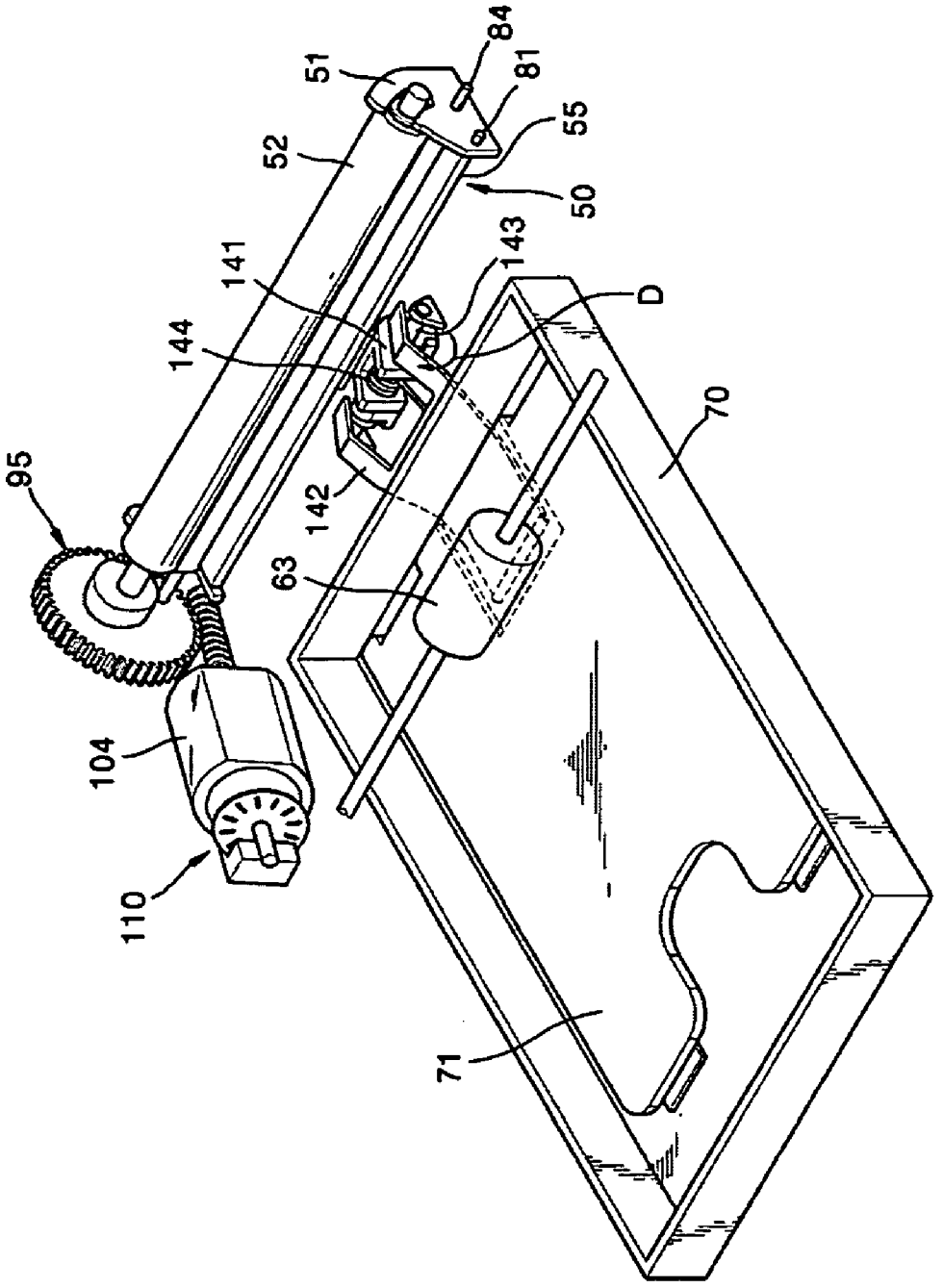

FIG. 7A

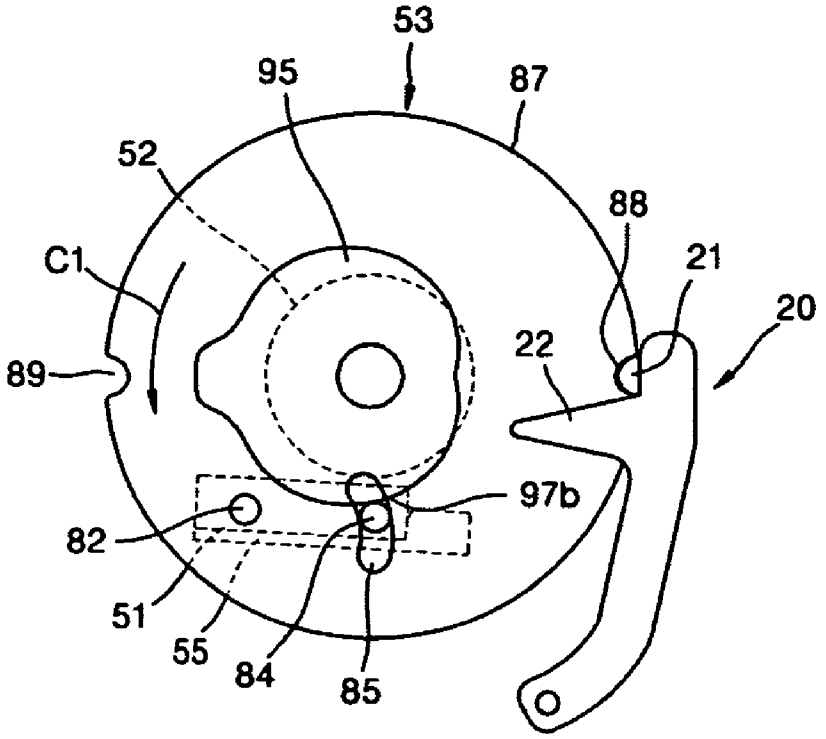
53
95
87
52
88
C1
21
20
89
22
97b
82
51
55
84
85

FIG. 7B

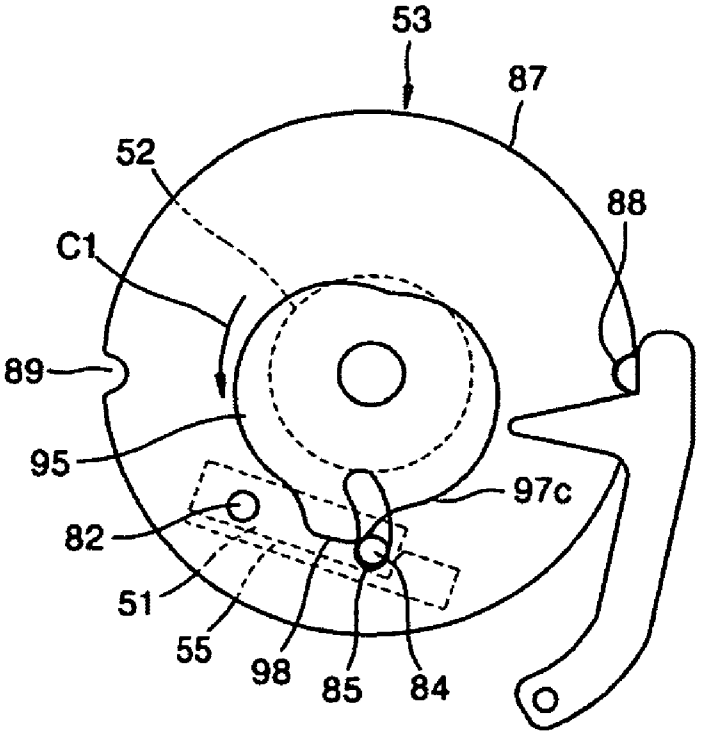
53
87
52
88
C1
89
95
97c
82
51
55
98
85
84

FIG. 7C

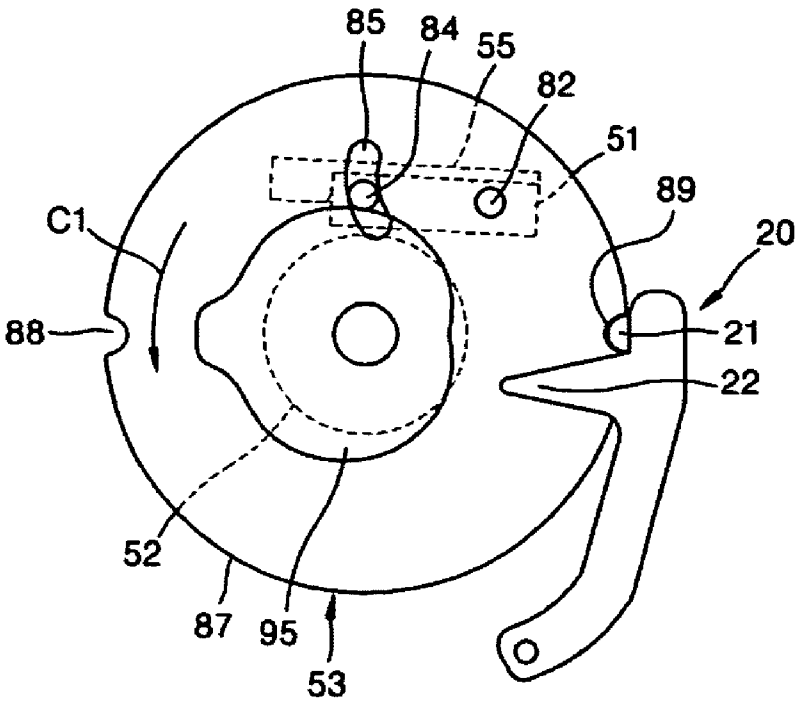
85
84
55
82
51
89
20
C1
88
21
22
52
87
95
53

FIG. 7D

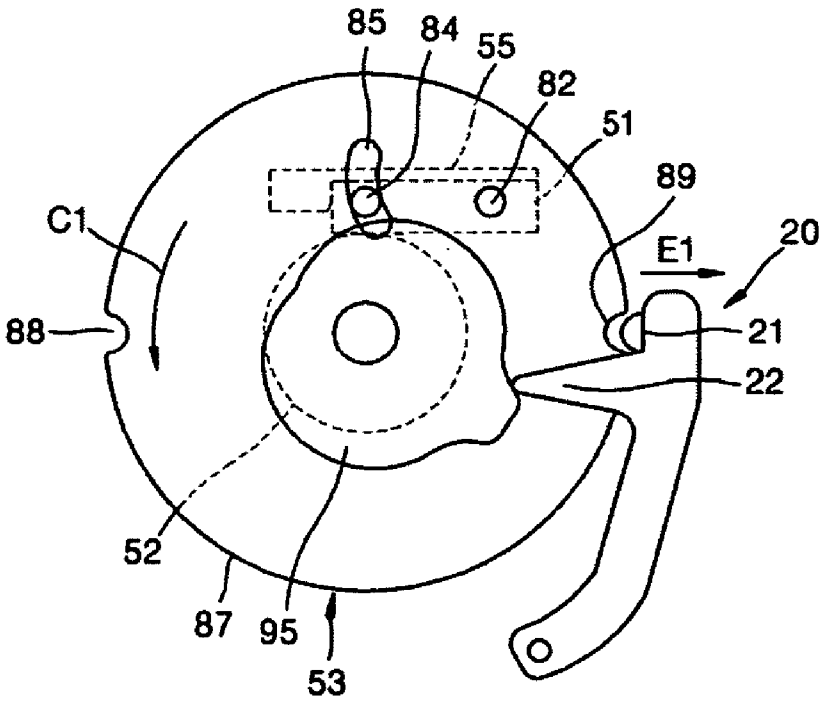
85
84
55
82
51
89
20
E1
C1
88
21
22
52
87
95
53

FIG. 8A

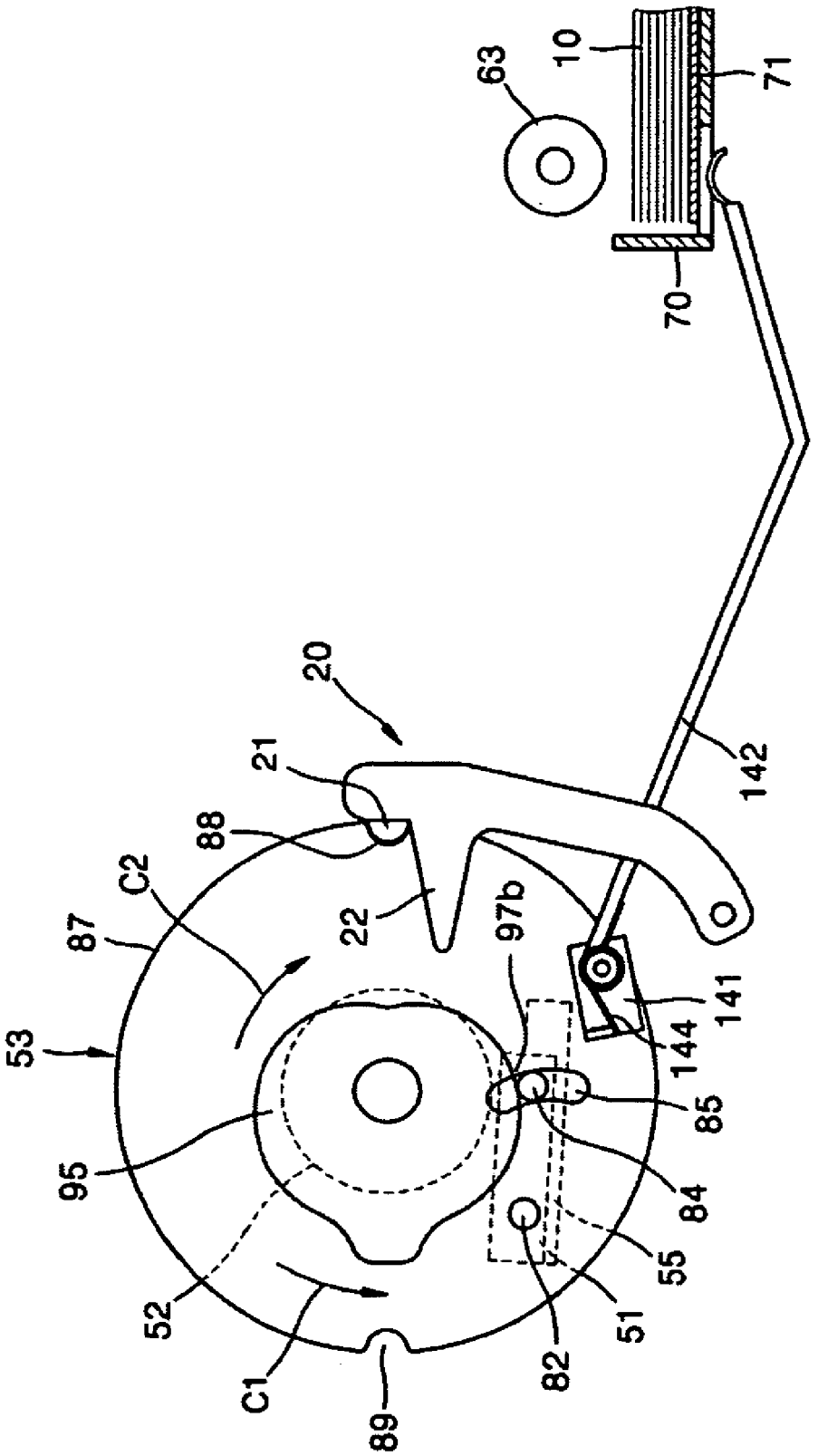
63
10
71
70
20
21
142
88
C2
87
22
97b
141
144
53
85
95
84
55
52
51
C1
82
89

FIG. 8B

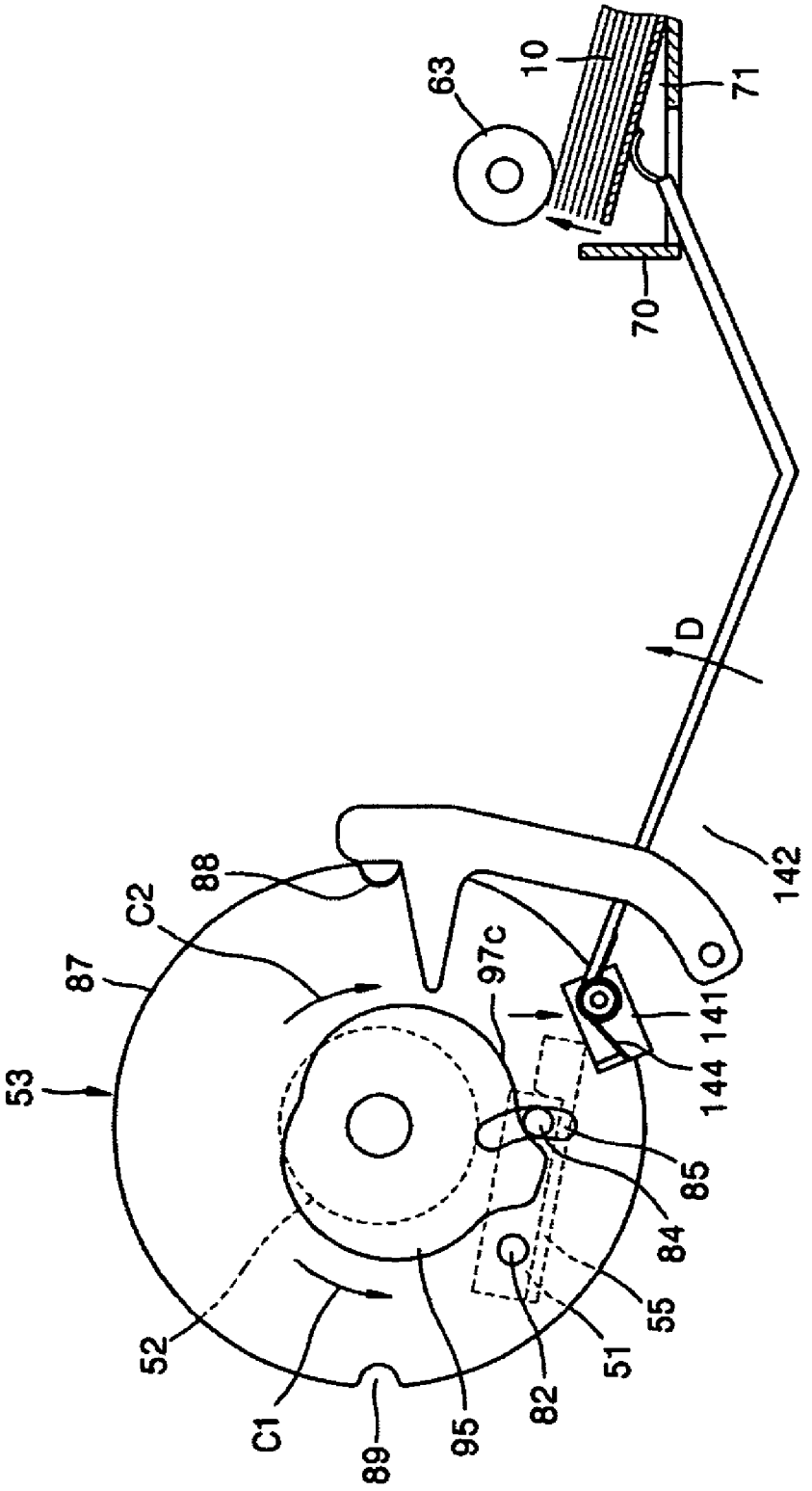

FIG. 8C

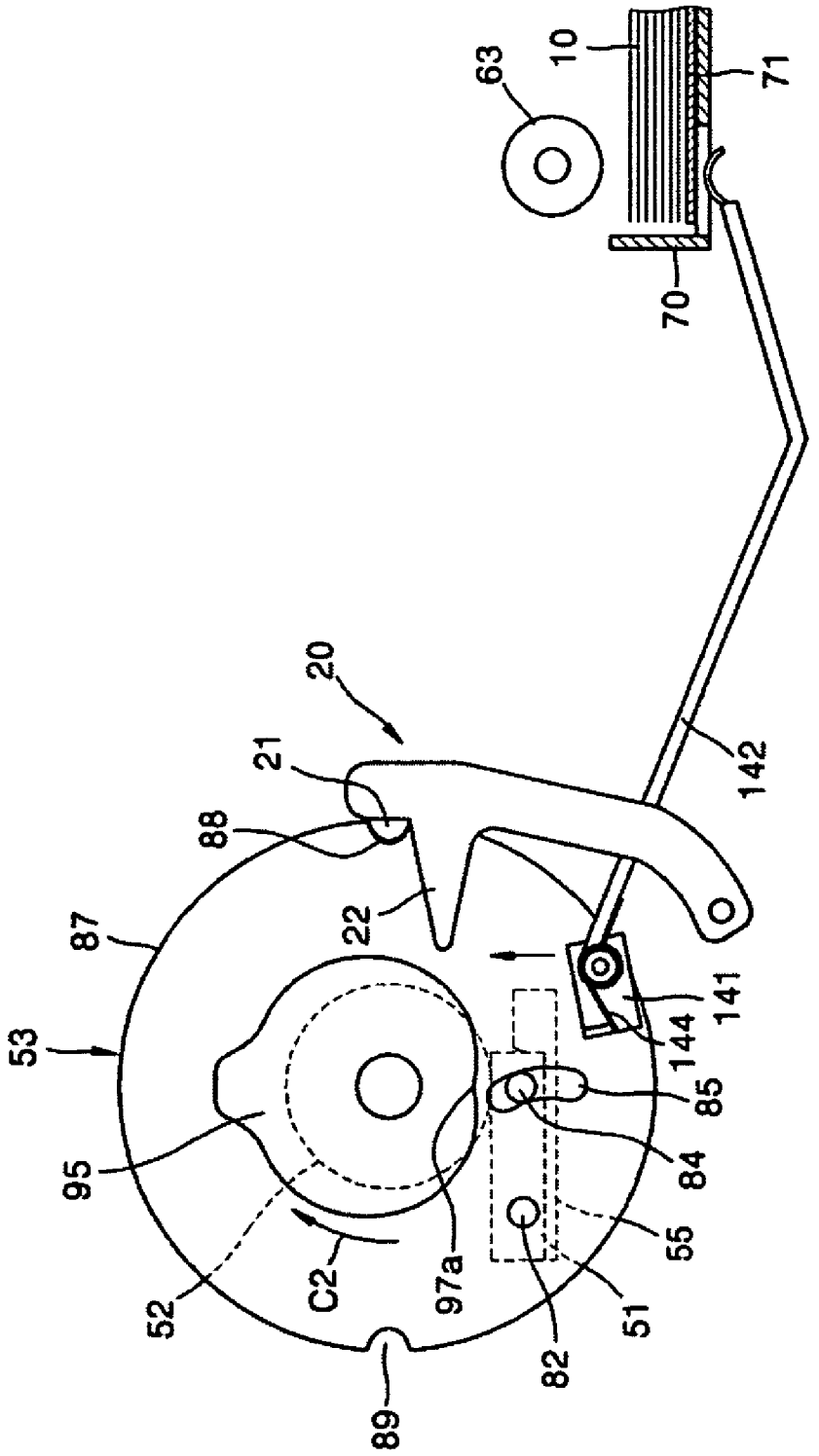
63
10
71
70
20
21
88
87
22
142
53
141
144
85
84
95
55
C2
97a
52
51
82
89

FIG. 8D

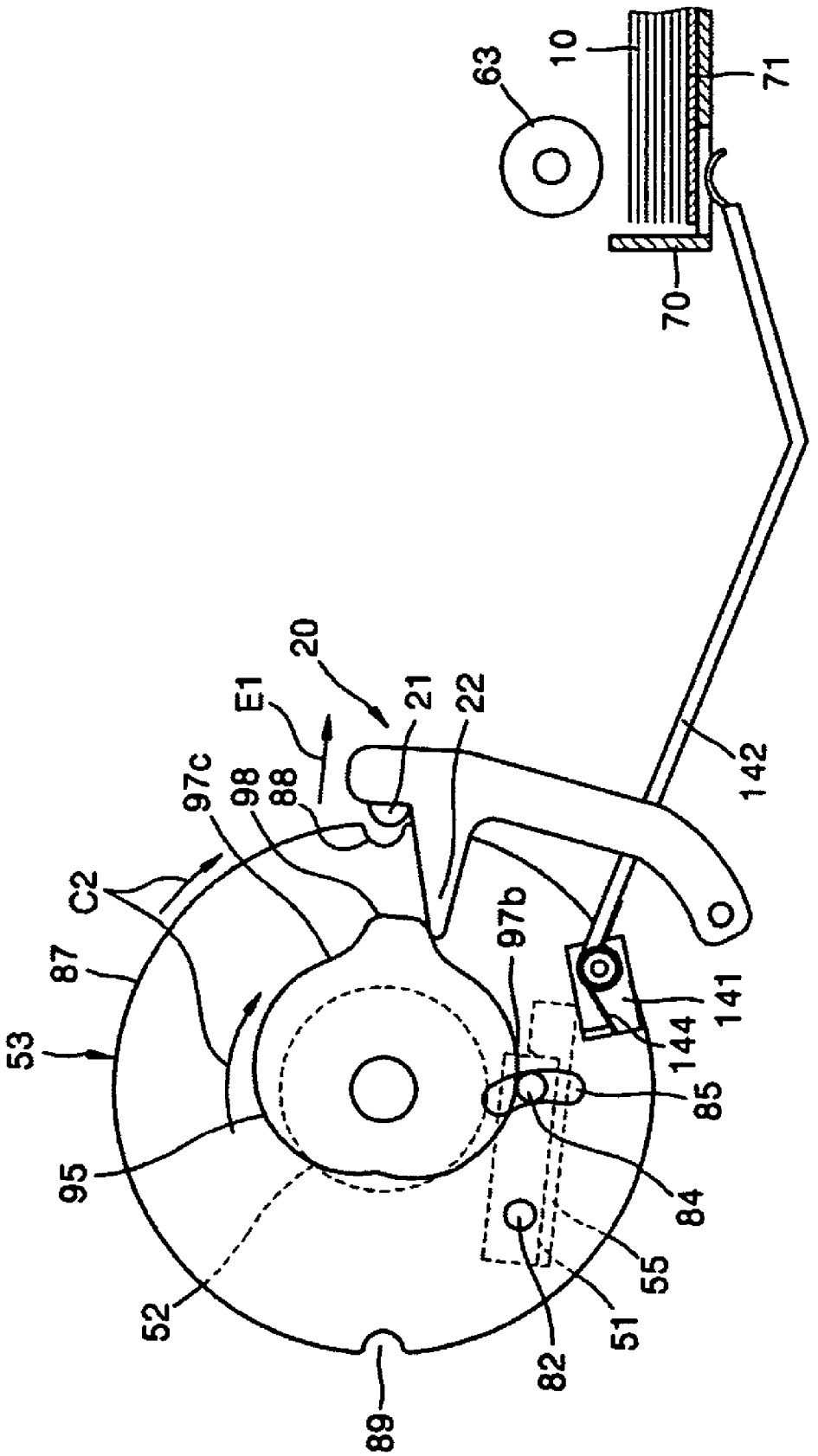
63
10
71
70
142
20
E1
21
22
97c
98
88
C2
87
53
95
52
89
97b
141
144
85
84
55
51
82

FIG. 8E

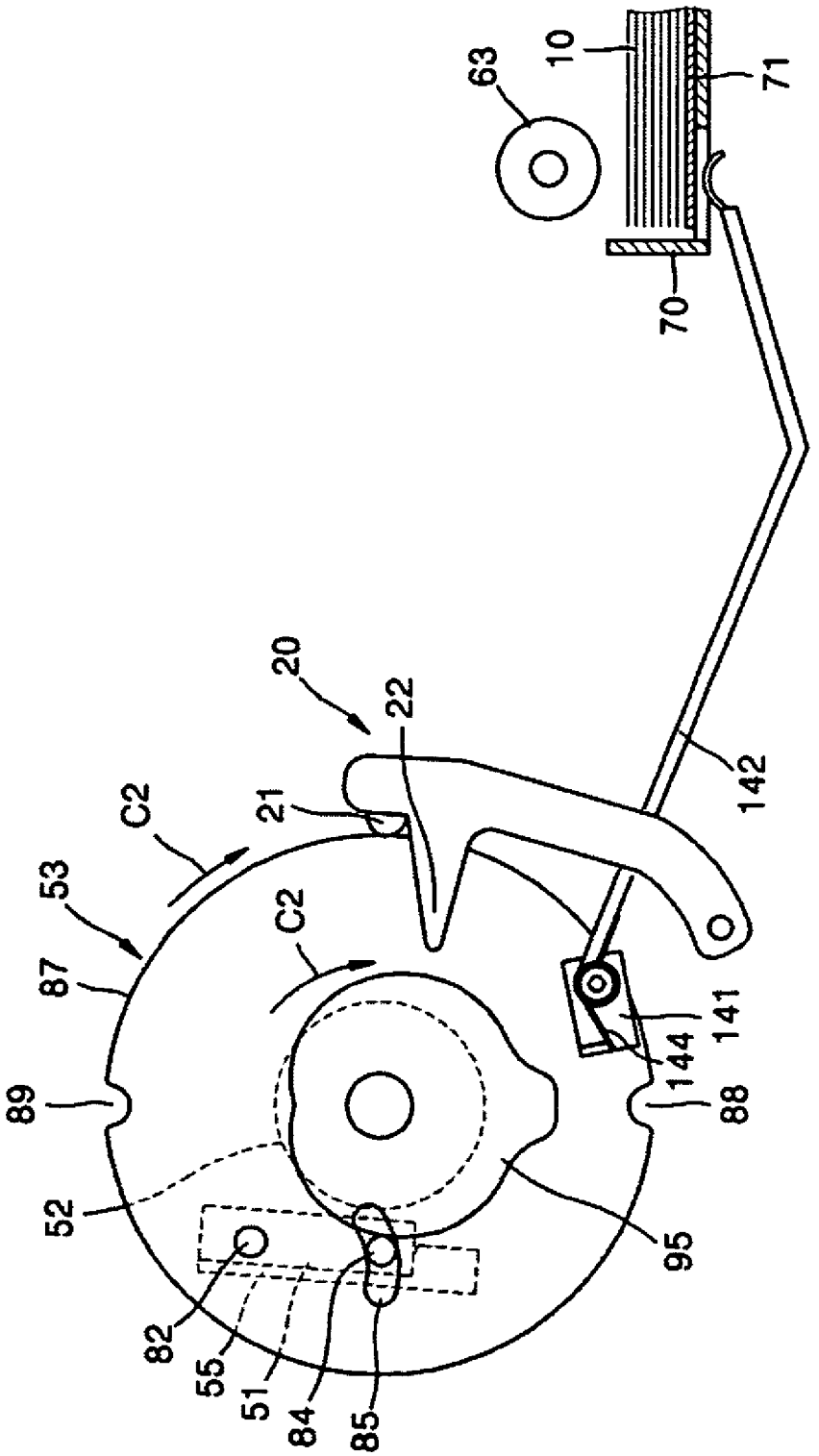

FIG. 8F

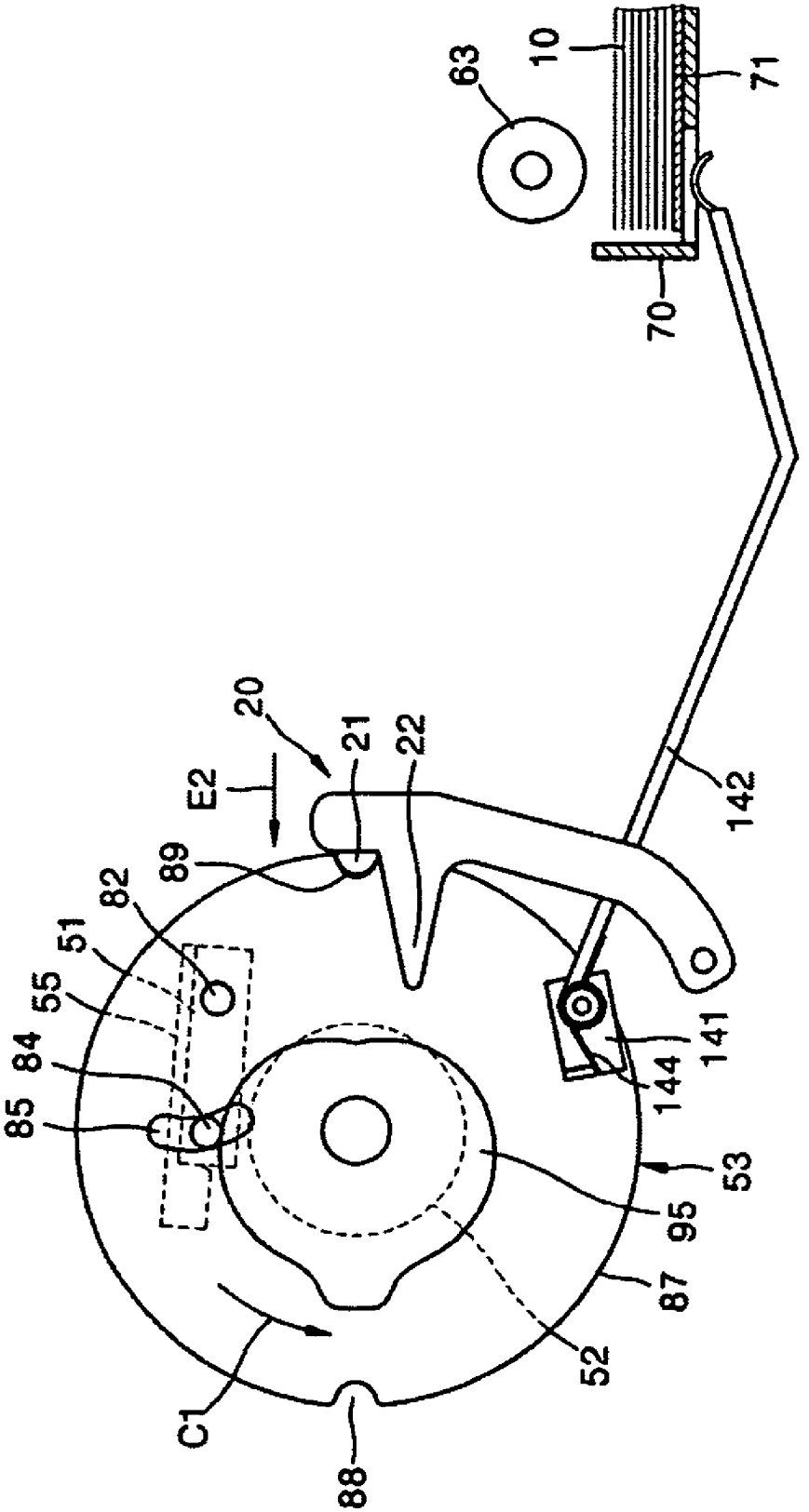

FIG. 8G

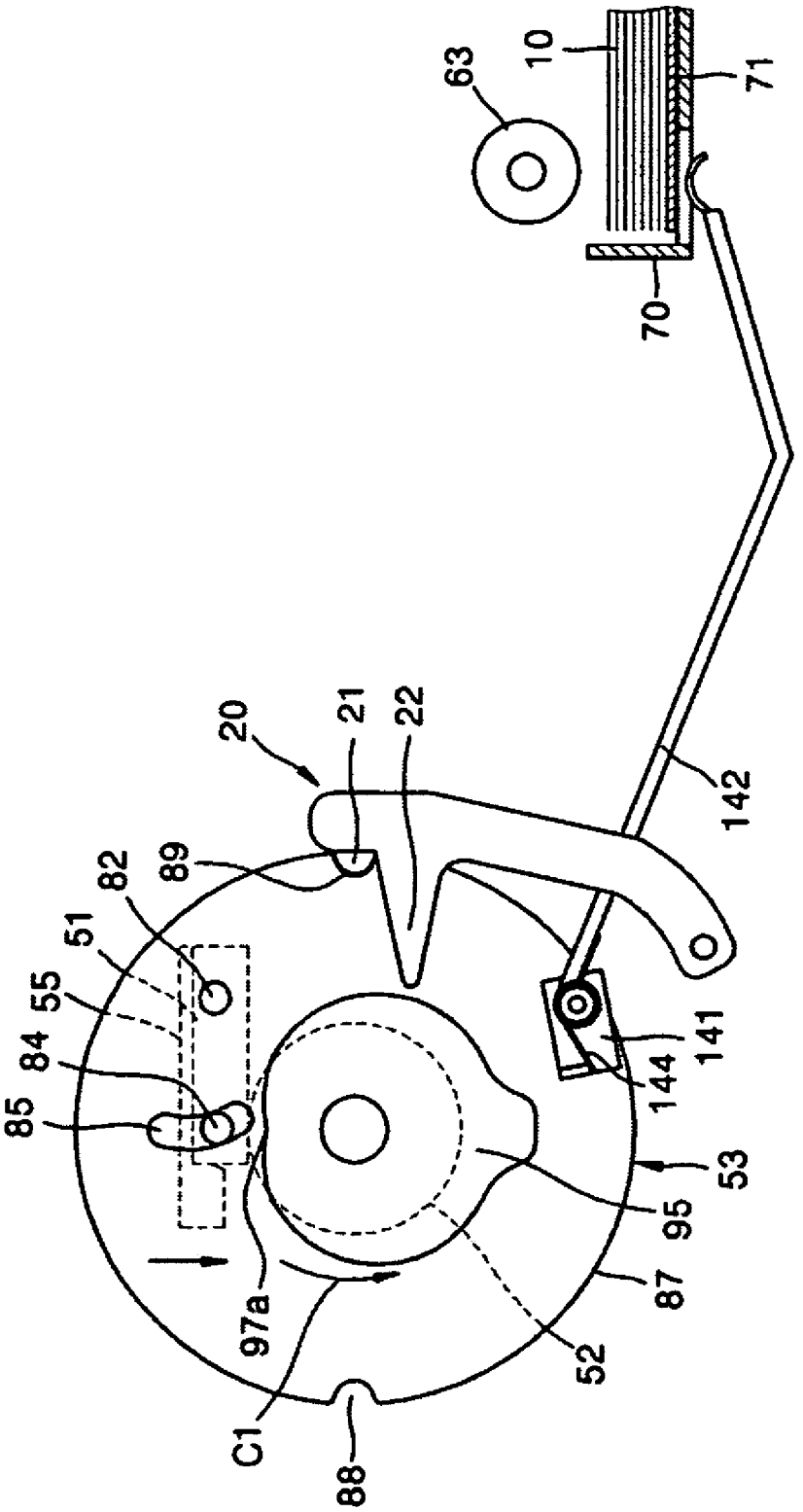
63
10
71
70
142
20
21
22
82
89
51
55
84
85
141
144
53
95
87
97a
52
C1
88

IMAGE FORMING APPARATUS USING THERMAL PRINTING HEAD

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This application claims the benefit under 35 U.S.C. § 119(a) of Korean Patent Application No. 10-2005-0042466, filed on May 20, 2005, in the Korean Intellectual Property Office, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus. More particularly, the present invention relates to an image forming apparatus that uses a thermal printing head (TPH).

2. Description of the Related Art

A thermal type image forming apparatus includes a thermal printing head (TPH) and a platen roller placed opposite to the TPH. To form a printing nip, the TPH is pressed toward the platen roller by a spring or the like. When a printing medium passes through the printing nip, the TPH prints an image on the printing medium by applying heat to the medium. The platen roller can be used as a main transfer means for transferring the printing medium at a predetermined printing speed. In addition, when a special transfer unit is provided for transferring the printing medium at the predetermined printing speed, the platen roller is rotated by a contact force generated between the printing medium and the platen roller. In this case, when the printing medium is supplied to the TPH and the platen roller, the TPH and the platen roller must be separated from each other. In addition, when printing is performed, the TPH must be pressed toward the platen roller.

To print an image on both sides of the printing medium (that is, duplex printing), two TPHs placed on the opposite sides of the printing mediums may be used, but the price of the image forming apparatus increases when two TPHs are used. Alternatively, duplex printing can be performed by using one TPH and bringing the TPH into opposition with first and second sides of a printing medium, sequentially. In this case, the TPH can be fixed while the printing medium is flipped over, or the TPH can be moved between opposite positions with respect to the first and second sides of the printing medium.

SUMMARY OF THE INVENTION

An aspect of the present invention is to address at least the above problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide a thermal type image forming apparatus that can make a thermal printing head (TPH) contact or separate from a platen roller. In addition, it is an aspect of the present invention to provide a thermal type image forming apparatus that can perform duplex printing by orderly transferring a TPH to opposite positions with respect to first and second sides of a printing medium.

According to an aspect of the present invention, an image forming apparatus includes a platen roller, a TPH unit facing the platen roller which pivots to contact or separate from the platen roller, a first elastic member which elastically biases the TPH unit toward the platen roller, a pair of cam levers provided in both sides of the TPH unit, and a pair of rotation cams which contact the pair of cam levers and allows the TPH unit to pivot according to a rotation angle thereof.

To initiate a phase of the pair of rotation cams, at least one of the pair of the rotation cams may include a stopper which is caught by the cam lever at a position where the TPH unit is separated form the platen roller by a maximum gap.

In addition, the apparatus may further comprise a cam motor rotating the rotation cam, and a metering means detecting a current applied to the cam motor. The phase of the rotation cam may be initiated when a current value rises when the stopper is caught by the cam lever.

In addition, the apparatus may further comprise a cam motor rotating the rotation cam, and an encoder generating a signal proportional to a rotation angle of the cam motor. The phase of the rotation cam may be initiated when the signal of the encoder is not generated when the stopper is caught by the cam lever.

In addition, the apparatus may further comprise a transfer unit for transferring a printing medium, and a driving motor for driving the transfer unit. The platen roller may be rotated by a contact force generated between the printing medium and the platen roller.

In addition, the TPH unit may be transferred to first and second positions to respectively face first and second sides of the printing medium.

In addition, the apparatus may further comprise a knock-up plate on which the printing medium is accommodated, a pick-up roller which picks up the printing medium, being placed separated from the printing medium, a transfer unit for transferring the printing medium, and a driving motor for driving the transfer unit and the pick-up roller. The knock-up plate may be transferred to a pick-up position where the printing medium accommodated thereon contacts the pick-up roller, and to a stand-by position where the printing medium accommodated thereon is separated from the pick-up roller.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features, and advantages of certain exemplary embodiments of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIGS. **1** and **2** are structural block diagrams of a thermal type image forming apparatus that performs duplex printing according to an exemplary embodiment of the present invention;

FIG. **3** is a sectional view of an example of a printing medium used in the present invention;

FIG. **4** is a perspective view of the thermal type image forming apparatus according to an exemplary embodiment of the present invention;

FIG. **5** is a partially exploded perspective view of a thermal type image forming apparatus according to an exemplary embodiment of the present invention;

FIG. **6** is an exploded perspective view of a unit for lifting a knock-up plate toward pick-up and stand-by positions according to an exemplary embodiment of the present invention;

FIG. **7**A to D are views of a process of initiating a motion of a rotation cam; and

FIG. **8**A to G are views of a process of printing an image on both sides of the printing medium.

Throughout the drawings, the same drawing reference numerals will be understood to refer to the same elements, features, and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

The matters defined in the description such as a detailed construction and elements are provided to assist in a comprehensive understanding of the exemplary embodiments of the invention. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the exemplary embodiments described herein can be made without departing from the scope and spirit of the invention. Also, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

An image forming apparatus according to an exemplary embodiment of the present invention will be now described in detail with reference to the accompanying drawings.

FIG. **1** is a block diagram illustrating the image forming apparatus according to the exemplary embodiment of the present invention, which includes a thermal printing head (TPH) **51** and a platen roller **52**. A first elastic member **83** pushes the TPH **51** toward the platen roller **52**, and the platen roller **52** contacts the TPH **51** to form a printing nip N. A knock-up plate **71** is pivotable installed in a cassette **70**. A printing medium **10** is placed on the knock-up plate **71**. A pick-up roller **63** for picking up the printing medium **10** is installed at the front side of the knock-up plate **71**. A transfer unit **40** transfers the printing medium **10** in first and second directions A**1** and A**2**. The transfer unit **40** includes a transfer roller **41** and an idle roller **42** engaged with the transfer roller **41**. A discharging unit **60**, which discharges the printing medium **10**, includes a discharging roller **61**, which rotates in engagement with the pick-up roller **63**, and an idle roller **62** engaged with the discharging roller **61**. The platen roller **52** is not connected to a driving motor **30**. The platen roller **52** contacts the printing medium **10** and rotates as the printing medium **10** is transferred by the transfer unit **40**. According to the aforementioned structure of the invention, because the driving motor **30** is provided only to rotate the transfer unit **40** and the pick-up roller **63**, a power connection structure is simplified.

A rotating force of the driving motor **30** is not directly transferred to the platen roller **52**. Thus, the TPH **51** and the platen roller **52** must be separated from each other when the printing medium **10** is transferred in the first direction A**1** and supplied between the TPH **51** and the platen roller **52**. Preferably, to prevent damage to the printing medium **10**, no force is applied on the printing medium when printing is not performed. Therefore, even if the platen roller **52** is connected to the driving motor **30**, the TPH **51** and the platen roller **52** are preferably separated from each other when the printing medium **10** is transferred in the first direction A**1** and supplied between the TPH **51** and the platen roller **52**. In addition, when the printing medium **10** is transferred in the second direction A**2**, the printing nip N is preferably formed by using an elastic force of the first elastic member **83**.

To transfer the printing medium **10** in the first and second directions A**1** and A**2**, the driving motor **30** is forwardly or reversely rotated. In addition, because the pick-up roller **63** is connected to the driving motor **30**, the pick-up roller **63** continuously rotates when the driving motor **30** is rotating. Therefore, the printing medium **10** placed on the knock-up plate **71** must be in contact with the pick-up roller **63** only when the pick-up process is performed, while the printing medium **10** placed on the knock-up plate **71** must be separated from the pick-up roller **63** when the pick-up process is completed. To this end, the knock-up plate **71** is pivoted to a pick-up position where the printing medium **10** is in contact with the pick-up roller **63**, and to a stand-by position where the printing medium **10** is separated from the pick-up roller **63** (shown in FIG. **2**).

The TPH **51**, which is placed opposite to the platen roller **52**, has a contact position where the TPH **51** contacts the platen roller **52** to form the printing nip N, a first open position where the TPH **51** is separated from the platen roller **52** by a first gap, and a second open position where the TPH **51** is separated from the platen roller **52** by a second gap which is greater than the first gap. The knock-up plate **71** is positioned in the pick-up position when the TPH **51** is positioned in the second open position, while it is positioned in the stand-by position when the TPH **51** is positioned in the contact position or the first open position.

To perform duplex printing using the TPH **51**, the TPH **51** is transferred to a first position (shown in FIG. **1**), which is opposite position to a first side M**1** of the printing medium **10**, and a second position (shown in FIG. **2**), which is opposite position to a second side M**2** of the printing medium **10**.

The medium **10** may have a structure as illustrated in FIG. **3**. Referring to FIG. **3**, ink layers L**1** and L**2** with predetermined colors are formed on both surfaces of a base sheet S, which are first and second surfaces M**1** and M**2**, respectively. The ink layers L**1** and L**2** may include a single layer for representing a single color, or multiple layers for representing two or more colors. For example, the ink layer L**1** on the first surface M**1** of the base sheet S may be formed of two layers to express the colors yellow Y and magenta M, and the ink layer L**2** on the second surface M**2** thereof may be formed of a single layer to express the color cyan C. The ink layers L**1** and L**2** may represent identical colors. These descriptions are given as examples, and the present invention is not limited by the structure of the ink layers of the first and second surfaces M**1** and M**2** of the printing medium **10**.

If the base sheet S is transparent, an opaque film may be formed on one of the ink layers L**1** and L**2**, for example, the ink layer L**1**. The TPH **51** is located at a first position and prints images with Y and M colors by heating the ink layer L**1**. The TPH **51** is located at a second position and prints an image with a C color by heating the ink layer L**2**. A complete color image in which the Y, M. and C color images overlap can be recognized when the image is viewed from the side of the base sheet S on which the ink layer L**2** is formed. On the other hand, if the base sheet S is opaque, and identical color ink layers are formed on the first and second surfaces M**1** and M**2**, double-sided printing is possible by printing different images on the first and second surfaces M**1** and M**2** of the medium **10**.

FIGS. **4** and **5** are a perspective view and a partially exploded perspective view of the thermal type image forming apparatus shown in FIGS. **1** and **2**. A frame **100** includes a base **101** in a lower part thereof and two side-plates **102** and **102***a* which are vertically positioned along both sides thereof. The TPH unit **50**, the transfer unit **40**, the discharging unit **60**, and the cassette **70** are installed in the frame **100**. Although not shown, the driving motor **30** (shown in FIGS. **1** and **2**) may be joined with the side-plate **102***a*.

The TPH unit **50** includes the TPH **51** and a holder **55** which supports the TPH **51**. The holder **55** may additionally function as a heat sink for dissipating heat generated from the TPH **51**. A hinge shaft **81** and a cam lever **84** are provided on both sides of the holder **55**.

Bushings **90** are joined in a hole **107** in the side-plates **102** and **102***a*. The bushings **90** include an inner circumference **91** and a first outer circumference **92**. Both ends **52***a* of the platen roller **52** are inserted into the inner circumference **91**

of the two bushings **90** joined with the side-plates **102** and **102***a*. A pair of supporting brackets **53** are joined in the first outer circumference **92** of the two bushings **90** to be capable of rotating. The hinge shaft **81** is inserted into a hinge hole **82** included in the pair of the supporting brackets **53**. The TPH unit **50** is joined with the pair of supporting brackets **53** in a rotatable manner around the hinge hole **82**. A rotation guide **103** is joined with the pair of the supporting brackets **53**. The rotation guide **103** guides the printing medium **10**, which is supplied from the transfer unit **40**, to a position between the TPH **51** and the platen roller **52**.

The TPH **51** is elastically biased by the first elastic member **83** in a direction of contacting the platen roller **52**. Referring to FIG. **5**, for example, a tensile coil spring may be used as the first elastic member **83**, one end of which is in contact with the holder **55** and other end of which is in contact with the cover **103** for covering the platen roller **52**. The cam lever **84** is inserted into a through-hole **85** included in the supporting bracket **53**. To allow the TPH unit **50** to pivot, the through-hole **85** preferably has a circular arc shape whose center is at the hinge hole **82**.

The bushings **90** further include a second outer circumference **93** which is coaxial with the first outer circumference **92**. A pair of rotation cams **95** are rotatably joined in the second outer circumference **93** of the two bushings **90**. The pair of rotation cams **95** includes a gear **96** and a cam **97** which is in contact with the cam lever **84**. The cam **97** includes first, second, and third cam surfaces **97***a*, **97***b*, and **97***c* and is eccentrically disposed with respect to the rotation axis of the rotation cam **96**. The first, second, and third cam surfaces **97***a*, **97***b*, and **97***c* correspond to the contact position, the first open position, and the second open position of the TPH **51**, respectively. A stopper **98** is included on one of or both of the pair of rotation cams **95**. A cam motor **104** includes a worm gear **105** which is engaged with the gear **96**. A bracket **106**, which is joined with the cam motor **104**, is joined with the side-plate **102**. Accordingly, the pair of supporting brackets **53** and the pair of rotation cams **95** have the same rotation axis.

An encoder **110** generates a signal proportional to the rotation angles of the cam motor **104**. The image forming apparatus may further include a metering means which measures a current applied to the cam motor **104**.

A pair of gears **131**, which are engaged with the gears **96** of the pair of rotation cams **95**, respectively, are joined to both ends of a shaft **130**. Accordingly, when the cam motor **104** rotates, the pair of rotation cams **95** also rotate.

The supporting bracket **53** has a circular outer circumference **87**. First and second joining notches **88** and **89**, which are separated from each other by about 180 degrees, are formed on the outer circumference **87**. A locking member **20** is rotatably joined to the side-plate **102**. A second elastic member **25** provides the locking member **20** with an elastic force in a direction where the locking member **20** joins with the first and second joining notches **88** and **89**. The locking member **20** is joined with the first and second joining notches **88** and **89** by the elastic force of the second elastic member **25** and is separated from the first and second joining notches **88** and **89** by the rotation cam **95**. The locking member **20** includes a protrusion **21**, which is joined with the first and second joining notches **88** and **89**, and a snag **22**, which interferes with a cam portion **97** of the rotation cam **95**. The locking member **20** and the second elastic member **25** may be provided on the side-plate **102***a*.

FIG. **6** is an exploded perspective view of a unit for lifting the knock-up plate **71**. Here, the supporting bracket **53** is not shown, and a single rotation cam **95** is shown. First and second arms **141** and **142** are rotatably installed on a shaft **143**. The first arm **141** is extended downward to the TPH unit **50**. The second arm **142** is extended downward to the knock-up plate **71**. A torsion spring **144** (a third elastic member) elastically connects the first and second arms **141** and **142**. One end of the torsion spring **144** is supported by the first arm **141**, and the other end is supported by the second arm **142**. When the TPH **51** pivots from the contact position toward the first open position, the first arm **141** does not contact the holder **55**. When the TPH **51** pivots toward the second open position, the holder **55** pushes the first arm **141**. As a result, the first arm **141**, the torsion spring **144**, and the second arm **142** are rotated toward a direction indicated by an arrow D in FIG. **6**. The second arm **142** pushes the knock-up plate **71** up to the pick-up roller **63**. The printing medium **10**, which is kept on the knock-up plate **71**, elastically contacts the pick-up roller **63** by an elastic force of the torsion spring **144**. When the TPH **51** pivots from the second open position toward the first open position, the first and second arms **141** and **142** and the torsion spring **144** are returned to their original positions due to the weight of the knock-up plate **71** and the printing medium **10** placed on the knock-up plate.

The phase of the rotation cam **96** has to be checked when the image forming apparatus is turned on or when the image forming apparatus receives a printing instruction from a host (not shown). To this end, the rotation cam **95** is rotated by driving the cam motor **104**.

Referring to FIG. **7**A, for example, when the image forming apparatus is turned on, the TPH **51** is positioned in the first position and the first open position. When the rotation cam **95** is rotated toward a direction C**1**, because the locking lever **20** is joined with the first joining notch **88**, the supporting bracket **53** is not rotated and the third surface **97***c* of the rotation cam **95** pushes the cam lever **84**. The TPH **51** pivots toward the second open position. Referring to FIG. **7**B, when the rotation cam **95** continues to rotate, the stopper **98** contacts the cam lever **84**, and the TPH **51** is no longer able to pivot because the TPH **51** reaches a maximum open position. Therefore, the rotation cam **95** is no longer able to be rotated either.

Referring to FIG. **7**C, as another example, when the image forming apparatus is turned on, the TPH **51** is positioned in the second position and first open position. When the rotation cam **95** is rotated toward the direction C**1**, because the locking lever **20** is joined with the second joining notch **89**, the supporting bracket **53** is not rotated and the TPH **51** pivots toward the contact position. Referring to FIG. **7**D, when the rotation cam **95** continues to rotate, the rotation cam **95** separates the locking member **20** from the second joining notch **89**. As a result, as the rotation cam **95** rotates, the supporting bracket **53** is also rotated toward the direction C**1**, and the TPH **51** rotates around the platen roller **52** to be positioned in the first position as shown in FIG. **7**A. The locking member **20** is joined with the first joining notch **88** by the elastic force of the second elastic member **25** and the supporting bracket **53** is no longer rotated. Although the rotation cam **95** continues to rotate and, as shown in FIG. **7**B, when the stopper contacts the cam lever **84**, the rotation cam **95** is no longer able to rotate.

Accordingly, when the rotation cam **95** is no longer able to rotate, a load imposed on the cam motor **104** increases, which leads to a sharp rise in a current value. Changes in the current value can be measured by using the metering means **120** to determine whether or not the stopper **98** of the rotation cam **95** contacts the cam lever **84**. Alternatively, when the rotation cam **92** is no longer rotated, a signal of the

encoder **110** is not generated. When the signal of the encoder **110** is not generated during a predetermined period even though current is continuously applied to the cam motor **104**, it can be determined that the stopper **98** of the rotation cam **95** and the cam lever **84** are in contact with each other.

As described above, by detecting a contact status between the stopper **98** and the cam lever **84**, the phase of the rotation cam **95** is initiated. The operation of initiating the phase of the rotation cam **95** can be performed when the image forming apparatus is turned on. In addition, to reduce operational errors, it can be performed any time before a printing operation is carried out.

Referring now to FIGS. **1**, **2**, **3** to **6**, and **8**A to **8**G, the printing operation will be described.

When the image forming apparatus is turned on according to the aforementioned process, the phase of the rotation cam **95** is initiated and then halted in a position, such as a position shown in FIG. **8**A. Referring to FIG. **8**A, the cam lever **84** contacts the second cam surface **97***b*. As a result, the TPH **51** is positioned at the first open position, wherein it is separated from the platen roller **52** by a first gap. In addition, as the protrusion **21** of the locking member **20** is caught in the first joining notch **88**, the TPH **51** is locked in the first position. Further, the first arm **21** is separated from the holder **55**, the knock-up plate **71** is in a lower position, and the printing medium **10** is separated from the pick-up roller **63**.

To pick up the printing medium **10**, referring to FIG. **8**B, the rotation cam **95** is rotated toward the direction C**1**. Since the supporting bracket **53** is locked by the locking member **20**, the supporting bracket **53** is not rotated. The third cam surface **97***c* pushes the cam lever **84** so that the TPH **51** pivots toward the second open position, wherein it is separated from the platen roller **52** by the second gap. Here, the holder **55** pushes the first arm **21** so that the first and second arms **21** and **22** are rotated toward a direction D. The second arm **22** pushes the knock-up plate **71** up toward the pick-up roller **63**. The knock-up plate **71** is positioned in the pick-up position. The printing medium **10**, which is placed on the knock-up plate **71**, elastically contacts the pick-up roller **63** by the elastic force of the torsion spring **144**.

The pick-up roller **63** extracts the printing medium **10** from the cassette **70** and the printing medium **10** is moved toward the transfer unit **40**. When the printing medium **10** is moved toward a transferable position by the transfer unit **40**, the rotation cam **95** is again rotated toward a direction C**2**. Then, the TPH **51**, the first and second arms **21** and **22**, and the knock-up plate **71** are returned to the positions shown in FIG. **8**A.

The transfer unit **40** transfers the printing medium **10** through the first gap to a position between the TPH **51** and the platen roller **52**. As the pick-up roller **63** and the printing medium **10**, which is placed on the knock-up plate **71**, are separated from each other, the printing medium **10** is not picked up even when the pick-up roller **63** is rotated. Then the transfer unit **40** is halted before a terminal end of the printing medium **10** is completely out of the transfer unit **40**.

To pivot the TPH **51** toward the contact position, the rotation cam **95** is rotated toward the direction C**2** in a state shown in FIG. **8**A. Since the protrusion **21** of the locking member **20** is joined with the first joining notch **88**, the supporting bracket **53** is not rotated. The cam lever **84** faces the first cam surface **97***a*. The TPH **51** is pivoted around the hinge hole **82** by the elastic force of the first elastic member **83** so that it is positioned in the contact position where the printing medium **10** is pushed toward the platen roller **52**, as shown in FIG. **8**C. Here, the first cam surface **97***a* and the cam lever **84** are preferably separated from each other. The transfer unit **40** transfers the printing medium **10** in the second direction A**2**. The TPH **51** prints an image by heating the first side M**1** of the printing medium **10**. The discharging unit **60** temporarily discharges the printing medium **10** on which the image is printed on the first side M**1**. When the printing process of the first side M**1** of the printing medium **10** is completed, the transfer unit **40** and the discharging unit **60** are halted. Here, the printing medium **10** is completely out of the TPH **51** and the platen roller **52**, and is caught in the transfer unit **40** and the discharging unit **60**.

Now, to print on the second side M**2** of the printing medium **10**, the TPH **51** is transferred in the second position which is opposite to the second side M**2** of the printing medium **10**, as shown in FIG. **2**. When the rotation cam **95** is rotated toward the direction C**2** in a state shown in FIG. **8**C, the third cam surface **97***c* and the stopper **98** push the snag **22** so that the locking member **20** is rotated toward a direction E**1** as shown in FIG. **8**D. As a result, the protrusion **21** is separated from the first joining notch **88** and the supporting bracket **53** is released to be able to rotate freely. Therefore, when the rotation cam **95** is continuously rotated toward the direction C**2** and the second cam surface **97***b* pushes the cam lever **84**, the supporting bracket **53** is rotated toward the direction C**2**, as shown in FIG. **8**E, instead of the TPH **51** being pivoted. When a blocking state generated between the third surface **97***c* and the snag **22** is terminated, the locking member **20** is continuously in contact with the outer circumference **87** of the supporting bracket **53** by the elastic force of the second elastic member **25**. Referring to FIG. **8**F, when the supporting bracket **53** is rotated by about 180 degrees, the locking member **20** is rotated toward a direction E**2** by the elastic force of the second elastic member **25** and the protrusion **21** is joined with the second joining notch **89**. The supporting bracket **53** is locked so that it does not rotate anymore. The TPH **51** is positioned in the first open position, wherein is separated from the platen roller **52** by the first gap.

The transfer unit **40** and the discharging unit **60** transfer the printing medium **10** in the first direction A**1**. Before the terminal end of the printing medium **10** is completely out of the transfer unit **40**, the transfer unit **40** is halted. The TPH **51** is in the opposite position with respect to the second side M**2** of the printing medium **10**. The rotation cam **95** is rotated toward the direction C**1** in a state shown in FIG. **8**F. Since the protrusion **21** of the locking member **20** is joined with the second joining notch **89**, the supporting bracket **53** is not rotated. The cam lever **84** faces the first cam surface **97***a*. The TPH **51** is rotated around the hinge hole **82** by the elastic force of the first elastic member **83** so that it is positioned in the contact position wherein the printing medium **10** is pushed toward the platen roller **52**, as shown in FIG. **8**G. Here, the first surface **97***a* and the cam lever **84** are preferably separated from each other. The transfer unit **40** transfers the printing medium **10** in the second direction A**2**. The TPH **51** prints an image by heating the first side M**1** of the printing medium **10**. The discharging unit **60** discharges the printing medium **10** on which the image is printed on both sides thereof.

When the duplex printing is completed, the rotation cam **95** is rotated toward the direction C**1**. The third cam surface **97***c* pushes the snag **22** so that the locking member **20** is able to rotate toward a direction E**1** as shown in FIG. **7**D. As a result, the protrusion **21** is separated from the second joining notch **89** and the supporting bracket **53** is released in a state where is able to rotate freely. Therefore, when the rotation cam **95** is continuously rotated toward the direction C**1** and the second cam surface **97***b* pushes the cam lever **84**, the

supporting bracket **53** is rotated toward the direction C1, instead of separating the TPH **51** from the platen roller **52**. When the blocking state generated between the third cam surface **97***c* and the snag **22** is terminated, the locking member **20** is continuously in contact with the outer circumference **87** of the supporting bracket **53** by the elastic force of the second elastic member **25**. When the supporting bracket **53** is rotated by about 180 degrees, the locking member **20** is rotated toward a direction E2 by the elastic force of the second elastic member **25** and the protrusion **21** is joined with the first joining notch **88**. The supporting bracket **53** is locked so that it does not rotate anymore. In addition, the TPH **51** is returned to the first position as shown in FIG. **8**A.

In the above-mentioned exemplary embodiment of the present invention, an image forming apparatus capable of duplex printing has been described. However, the unit for pivoting the TPH **51** to the contact position and the first and second open positions, the unit for transferring the knock-up plate **71** to the pick-up position and the stand-by position, and the unit for determining the motion of the rotation cam may also be used in an image forming apparatus where the TPH **51** is fixedly installed opposite to the first side M1 of the printing medium **10**. In this case, the hinge hole **82** may be included in the side-plates **102** and **102***a* of the frame **100**.

The cam motor **104** can rotate the rotation cam **95** so that the first, second, and third cam surfaces **97***a*, **97***b*, and **97***c* face the cam lever **84**, thereby moving the TPH **51** to the first and second open positions.

Accordingly, a thermal type image forming apparatus according to the present invention has following advantages.

First, when a single rotation cam is used for pivoting a TPH to a contact position and first and second open positions, gaps between the TPH and a platen roller may be different at both sides of the TPH. However, in the present invention, a pair of rotation cams are used so that the gaps (the first and second gaps) are constant at the both sides of the TPH. Therefore, in the process of supplying the printing medium between the TPH and the platen roller, the possibility of generating a medium jam can be reduced.

Second, a phase of the rotation cam can be initiated with a simple structure. Therefore, operational errors of the image forming apparatus, which are generated as phase errors accumulate, can be prevented.

Third, the platen roller is rotated by a contact force of the printing medium. Thus, a power connection structure for transferring the printing medium can be simplified.

Fourth, a knock-up plate is selectively lifted toward a pick-up roller by being engaged with a pivoting operation of the TPH in association with the rotation cam. Thus, an electric clutch or the like for controlling a driving force of the pick-up roller can be omitted, which has an advantage in improving price competitiveness.

Fifth, by using a single TPH, a low-cost image forming apparatus capable of duplex color printing can be realized.

Sixth, by using the rotation cam for pivoting the TPH, the TPH is transferred to be opposite to both sides of the printing medium. Thus, a very compact image forming apparatus can be realized.

While the invention has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A thermal type image forming apparatus comprising:

a platen roller;

a thermal printing head (TPH) unit facing the platen roller and pivoting to contact or separate from the platen roller;

a first elastic member which elastically biases the TPH unit toward the platen roller;

a pair of cam levers provided on both sides of the TPH unit; and

a pair of rotation cams which contact the pair of cam levers and allows the TPH unit to pivot according to a rotation angle thereof,

wherein the TPH unit rotates around the platen roller to be disposed in first and second positions where the TPH unit faces the first and second surfaces of a printing medium, and

to initiate a phase of the pair of rotation cams, at least one of the pair of the rotation cams includes a stopper which is caught by the cam lever at a position where the TPH unit is separated from the platen roller by a maximum gap.

2. The apparatus according to claim **1**, further comprising:

a cam motor for rotating the rotation cam; and

a metering means for detecting a current applied to the cam motor, wherein the phase of the rotation cam is initiated when a current value rises when the stopper is caught by the cam lever.

3. The apparatus according to claim **1**, further comprising:

a cam motor rotating the rotation cam; and

an encoder generating a signal proportional to a rotation angle of the cam motor, wherein the phase of the rotation cam is initiated when the signal of the encoder is not generated when the stopper is caught by the cam lever.

4. The apparatus according to claim **1**, further comprising:

a transfer unit for transferring a printing medium; and

a driving motor for driving the transfer unit, wherein the platen roller is rotated by a contact force generated between the printing medium and the platen roller.

5. The apparatus according to claim **1**, further comprising:

a pair of supporting brackets capable of rotating around the platen roller, the pair of supporting brackets pivotably supporting the TPH unit.

6. The apparatus according to claim **5**, further comprising:

first and second joining notches formed in the supporting bracket;

a locking member for locking the supporting bracket by selectively joining with the first and second notches; and

a second elastic member which allows the locking member to be elastically biased toward a joining direction of the first and second joining notches, wherein the rotation cam pushes the locking member so that the locking member is separated from the first and second joining notches.

7. The apparatus according to claim **6**, wherein:

when the pair of rotating cams contacts the pair of cam levers and rotates in a condition where the locking member is separated from the first and second joining notches, the pair of supporting brackets rotates so that the TPH unit is transferred to the first and second positions where the TPH unit faces the first surface of the medium and the second surface facing thereto; and

when the pair of rotating cams contacts the pair of cam levers and rotates in a state where the locking member is joined with the first and second joining notches, the TPH unit pivots.

8. The apparatus according to claim **1** further comprising:

a knock-up plate on which a the printing medium is placed;

a pick-up roller which picks up the printing medium, the pickup roller being separated from the printing medium;

a transfer unit for transferring the printing medium; and

a driving motor for driving the transfer unit and the pick-up roller,

wherein the knock-up plate is pivoted to a pick-up position where a medium loaded thereon contacts the pick-up roller and to a stand-by position where the medium is separated from the pick-up roller.

9. The apparatus according to claim **8**, wherein

the platen roller is rotated by a contact force generated between the printing medium and the platen roller.

10. The apparatus according to claim **9**, wherein

the TPH unit pivots toward a first open position to be separated from the platen roller by a first gap, and a second open position to be separated from the platen roller by a second gap which is greater than the first gap, and the knock-up plate is transferred to the pick-up position while the TPH unit pivots toward the second open position.

11. The apparatus according to claim **10**, further comprising:

a first arm which rotates in contact with the TPH unit when the TPH unit pivots to the second open position;

a second arm which is pivoted by the first arm to lift the knock-up plate to the pick-up position; and

another member which elastically joins the first and second arms.

12. The apparatus according to claim **10**, further comprising:

a pair of supporting brackets capable of rotating around the platen roller, wherein the TPH unit is installed to be pivotable in the pair of supporting brackets.

13. The apparatus according to claim **12**, further comprising:

first and second joining notches formed in the supporting bracket;

a locking member for locking the supporting bracket by selectively joining with the first and second notches; and

a second elastic member which allows the locking member to be elastically biased toward a joining direction of the first and second joining notches,

wherein the rotation cam pushes the locking member so that the locking member is separated from the first and second joining notches.

14. The apparatus according to claim **13**, wherein

when the pair of rotating cams contacts the pair of cam levers and rotates in a condition where the locking member is separated the first and second joining notches, the pair of supporting brackets rotates so that the TPH unit is transferred to the first and second positions facing the first surface of the medium and the second surface facing thereto; and

when the pair of rotating cams contacts the pair of cam levers and rotates in a condition where the locking member is joined with the first and second joining notches, the TPH unit pivots.

15. A thermal type image forming apparatus comprising:

a platen roller;

a thermal printing head (TPH) unit facing the platen roller, the TPH being pivotable between a contact position where the TPH contacts the platen roller, a first open position where the TPH is separated from the platen roller by a first gap, and a second open position where the TPH is separated from the platen roller by a second gap which is greater than the first gap;

a pair of supporting brackets capable of rotating around the platen roller, the pair of supporting brackets pivotably supporting the TPH unit;

a pair of cam levers provided on both sides of the TPH unit;

a pair of rotation cams that contact the pair of cam levers and allow the TPH unit to pivot according to a rotation angle thereof;

a knock-up plate for supporting a printing medium, the knock-up plate being pivotable between a pick-up position and a stand-by position; and

a pick-up roller for picking up the printing medium from the knock-up plate when the knock-up plate is in the pick-up position, the pick-up roller being separated from the printing medium in the stand-by position.

16. The apparatus according to claim **15**, further comprising:

a first arm which rotates in contact with the TPH unit when the TPH unit pivots to the second open position;

a second arm which is pivoted by the first arm to lift the knock-up plate to the pick-up position; and

an elastic member which elastically joins the first and second arms.

* * * * *